RESEARCH HIGHLIGHTS

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COMPLIANCE OF VENTILATION SYSTEMS INSTALLED TO MEET PROPOSED CHANGES TO THE 1995 NBCC

Introduction

A 1999 study found that few, if any, new residential ventilation systems were in full compliance with Section 9.32 "Ventilation" in the 1995 National Building Code of Canada (NBCC). Of particular concern was the finding that most new houses would not comply with the gas code CAN/CSA B149 depressurization limit for B-vented gas appliances even though they complied with NBCC Sub-section 9.32.3.8. "Protection Against Depressurization". Application of NBCC 9.32 permits depressurization at levels not permitted for B-vented gas appliances under the gas code.

To address this and other concerns, a multi-stakeholder Task Group was formed representing code officials, federal and provincial agencies, builders, mechanical trades, consultants, etc. This group reviewed mechanical ventilation for houses and proposed code changes to Section 9.32 of the 1995 NBCC. The proposed change included:

- allow exhaust-only ventilation systems in houses that do not have spillage-susceptible combustion appliances,
- impose rigorous make-up air requirements for houses with spillage-susceptible combustion appliances,
- require outdoor air supply ducts connected to forced-air system return ducts to have normally closed dampers which open automatically when the Principal Ventilation Fan is on,
- require airflow in outdoor air supply ducts to be measured and adjusted to within 10 per cent of the airflow of the Principal Ventilation Fan,
- base ventilation requirements on the number of bedrooms rather than total numbers of rooms,
- require CO detectors in houses with an attached garage, if installed exhaust devices can depressurize the house,
- provide a simple sizing procedure for ventilation system ducts.

CMHC commissioned a study to evaluate the effectiveness of the proposed code changes at dealing with shortcomings in the 1995 NBCC.

Research Program

The research program involved inspecting and testing houses with ventilation systems designed and installed to meet the proposed residential ventilation requirements. Key project tasks included:

- identifying residential ventilation system installers to participate in the study (note: in this Research Highlight, the word "installers" is used to describe those people who design, specify, and install heating and ventilation systems)
- providing participating installers with the proposed code requirements and an overview of the reasons for the proposed changes,
- reviewing ventilation system concepts proposed by participating installers for compliance with the proposed code,
- testing and inspecting ventilation systems installed in five houses in Manitoba and five in Alberta to assess field compliance,
- interviewing installers for their opinions on the proposed code changes and clarity of the requirements.

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Work was initiated on this project in late summer 2001. Inspections and testing of ventilation systems in study houses was completed in winter 2001/2002.

Results

Installer Responses to Proposed Changes

Installers liked the simplified method of determining ventilation requirements (i.e., bedroom count versus whole-house room count) and the requirement for CO detectors in houses with attached garages. Installers thought CO detectors should be required with attached garages, regardless of ventilation system type. Field study data showed houses are often at lower pressures than attached garages, even when exhaust devices are not operating. Finding suitable locations for CO detectors in unfinished basements will be a challenge.

Installers said the option of providing make-up air for each installed exhaust device would be too expensive to be considered and too complex to be properly and reliably applied, so should not be described in the code.

Installers expect builders to migrate to the lowest cost system. Thus, the proposed requirement for motorized dampers on outdoor air intake ducts would to lead to designs that did not include air intakes. Some felt that this would be a step backwards because outdoor air intakes connected to furnace returns ensure some ventilation regardless of occupant action, which helps protect the house from excess moisture during cold weather. One said homeowners do not understand the need for ventilation, and the code should mandate automatic controls which do not rely on occupants to initiate ventilation. Others thought measures to reduce over-ventilation were needed.

Field Study Findings

For the most part, residential ventilation systems provided for this study were simple variations of the systems being installed to comply with the 1995 NBCC. As installed, most systems had too much airflow to comply with the Principal Ventilation Airflow Rate requirements of both the proposed changes and the 1995 NBCC, but not enough airflow from quiet fans to meet the Minimum Ventilation Capacity in the 1995 NBCC. Most installers used direct-vent space heating appliances. Manitoba houses used electric domestic hot water tanks; most Alberta houses used power-vented or direct-vent gas water heaters. Data on performance of Principal Ventilation Fans are presented in Table 1.

Two ventilation systems demonstrated attempts to find compliance routes which would work with chimney-vented furnaces. One had a 150 mm diameter outdoor air intake with a motorized damper connected to the furnace return which provided make-up air for the Principal Ventilation Fan (i.e., the ensuite exhaust). The Principal Ventilation System in the other was a passive HRV with its outdoor air supply and exhaust ducts connected to the furnace return and supply air ductwork. Both houses had 150 mm diameter make-up air ducts with motorized dampers to relieve depressurization caused by exhaust devices. Operating any exhaust device caused the motorized dampers in the outdoor air intakes and relief air ducts to open and the furnace fan to operate.

Although these strategies appeared to comply with 1995 NBCC 9.32 requirements for protection against depressurization, operating installed exhaust devices depressurized both houses more than allowed in the proposed changes to 9.32 or CAN/CSA B149. In an effort to remedy this, a make-up air fan interlocked with the rangehood was installed. This configuration also failed to provide the required protection from depressurization. This reaffirms that it is not practical to rely on envelope leakage, passive make-up air ducts and/or a single make-up air fan to provide the protection against depressurization required for chimney-vented combustion appliances.

Operating installed exhaust devices induced depressurization of up to 25 Pa in study houses. Not all study houses had rangehoods connected or dryers installed at the time of testing. If they had been, it is expected that maximum depressurization levels would have exceeded 25 Pa in at least two study houses. Similar levels of depressurization observed in a previous study prompted the proposed changes to the 1995 NBCC evaluated herein. While these depressurization levels may comply with code requirements for houses that do not have chimney-vented combustion appliances, they may have unanticipated effects on mechanical systems (e.g., power-vented water tanks or direct-vent fireplaces) or indoor air quality.

Ventilation system fans (except bath fans and rangehoods) had means to adjust airflows installed. However, airflow measurements made in the field study indicated installers did not measure or adjust airflows to comply with code requirements, even for HRV systems. The requirement to measure and adjust residential ventilation system airflows will be difficult to enforce.

When the 1995 NBC was adopted, many installers were challenged by the requirement to coordinate the operation of the Principal Ventilation Fan and the furnace circulation fan. Since then, effective solutions have been developed and this issue has been resolved.

Implications for the Housing Industry

The study reaffirms the researcher's opinion that compliance with the depressurization limits in CSA B149 and in the proposed changes to NBCC Section 9.32 can only be effectively achieved by not installing spillage-susceptible combustion appliances in houses. Relying on envelope leakage, passive make-up air ducts and/or a single make-up air fan is not a practical approach to protect spillage-susceptible combustion appliances from excessive depressurization.

Builders that currently install chimney-vented combustion appliances will encounter a significant increase in mechanical system costs if the proposed code changes come into effect. However, many of these do not comply with existing restrictions on depressurization. If compliance with these requirements were enforced, the proposed ventilation requirements may be less costly to meet than current requirements.

Builders that do not install chimney-vented combustion appliances (as is the case for many Manitoba builders) would find the least-cost system in the proposed code to be simpler and less expensive to meet than the current code (ignoring the requirement to measure and adjust airflows). This cost reduction will result from the move to exhaust-only ventilation, and the ability to use either a smaller central fan or a single fan to meet the exhaust requirements of both the kitchen and the bathrooms. The proposed code should only involve minor changes to current "good practice" for HRV installations.

There may be an increase in moisture-related problems in houses if builders choose the exhaust-only ventilation system option. Permitting modest-sized outdoor air intakes (say 100 mm) without requiring airflow measurement or installation of a motorized damper may reasonably address installer and builder concerns about under-ventilation; furnace manufacturer concerns about cold return air temperatures; and homeowner concerns about excess energy costs.

Meeting the proposed requirement to measure and adjust ventilation system airflows will require most installers to learn new skills and will increase installation costs. This requirement is unlikely to be met, unless it is enforced.

Table 1

House	Required Airflow (L/s)		Measured Airflow (L/s)	
	Proposed Code	1995 NBCC	Low Speed	High Speed
Man1	22 to 32	24 to 36 High 60	35	43
Man2	26 to 38 High 65	22 to 33 High 55	exh 27 sup 28	62 58
Man3	22 to 33	22 to 32 High 55	42	68
Man4	26 to 38	32 to 48 High 80	44	70
Man5	22 to 32	26 to 39 High 65	exh 38 sup 37	55 57
AB1	26 to 38	32 to 48	exh 33 sup 37	60 56
AB2	22 to 32	22 to 33 High 55	43	NA
AB3	22 to 32	22 to 33 High 55	35	NA
AB4	22 to 32	26 to 39 High 65	exh 24 sup 18	NA
AB5	22 to 32	26 to 39 High 65	Exh 63 sup 63	89 89

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Housing Research at CMHC

Under Part IX of the *National Housing Act*, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

This fact sheet is one of a series intended to inform you of the nature and scope of CMHC's research.

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